Feasibility of guayule commodity chain in the Mediterranean region

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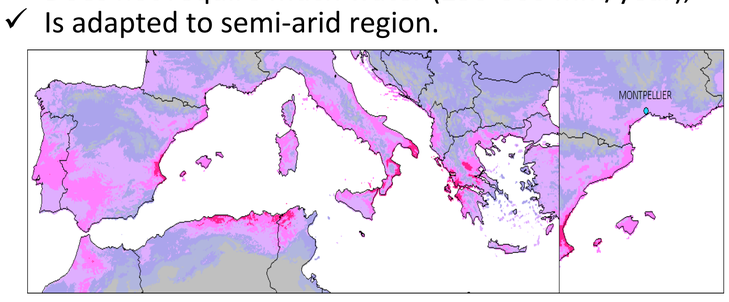
Why Guayule in the Mediterranean area?

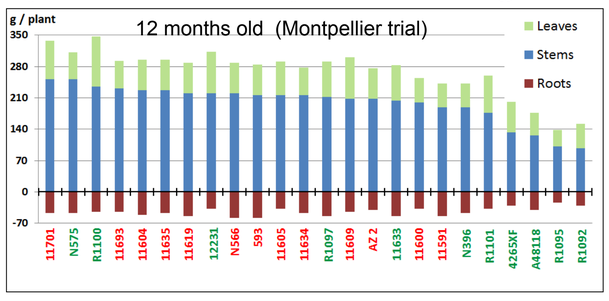
Because Mediterranean ecologies are suitable for a crop that:

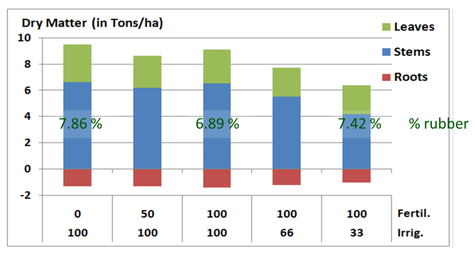
- ✓ Does not require much water (250-600 mm/year),
- ✓ Is adapted to semi-arid region.



Many Mediterranean areas are suitable to grow guayule.

Guayule varieties adapted to the region are available





Average % rubber = 7.4% ; Average % resin = 7.9 %
(*no statistical differences between treatments*).

- ✓ Guayule trials were done under the EU-Pearl project in Montpellier and Cartagena.

Advantages of the Southern Mediterranean regions

Climate

- ✓ Climatic conditions of the Mediterranean are not very different from those of the Mexican desert;

Lands

- ✓ Land rental value is half the price of European rental value (in semiarid region).
- ✓ Most farmers have less than 5 ha.

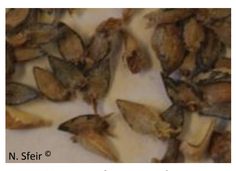
Labour

- ✓ Labour costs are lower than 20 % compared to European costs.

Interest for Mediterranean countries

- ✓ ***Water availability:*** South Mediterranean countries suffer with aridity. Water is a limiting factor, but there is groundwater which can be used for irrigation.
- ✓ Need for development projects and sustainable farming in the Mediterranean area (Climate Change).
- ✓ **Low input costs** in the south can increase farmers' revenues.
- ✓ Guayule production can be **close to European industry**.

Simplify model of a Guayule commodity chain



Guayule Seeds

a) Farmer

Biomass ready to be harvested

Source of Data

- **Cultural** and **crop management** are based on trials in Cartagena and Montpellier
- **Costs of inputs** calculated from agricultural costs in Spain and France.

Inputs:

Cultural practices and crop management used to compute the farmer's revenue (inputs + labour) were based on trials in Murcia and Montpellier.

➢ **Costs include:**

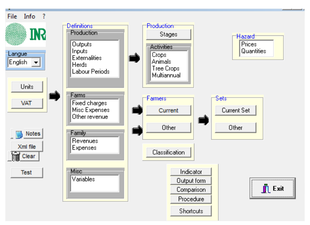
- Nursery for production of plantlets,
- Land preparation (ploughing, plastic mulching …) and planting,
- Land rental,
- Drip irrigation, Fertilization, Pesticides (not used, for record only),
- Labour for annual maintenance.

Uncertainty on some data were managed to assess the feasibility:

- Rubber yields,
- Plant behaviour to irrigation, fertilization,
- Harvest periodicity: annual & biannual.

Several hypothesis and simulations were done

Simulations were done using a farm simulation software (Olympe™)



Results of two simulations

Inputs:

Total costs (fixed and variable) — **Price /ton /year**

	Irrigation	Fertilisation	Yields
Simul 1	100% (1600 m³ /ha/year)	100% (240 kg NPK /ha/year)	**€ 147**
Simul 2	100%	50%	**€ 142**

(*Averages of ten-year cultivation*)

Outputs:

Trials show that farmer can produce 12 tons of stem dry biomass / ha / year.
Biomass is sold at **€ 300 / ton** (*to the manufacturer*).

Benefit for the farmer = € 300 – € 147 = **€ 153 / ton biomass**

Harvesting

b) Manufacturer

Rubber product

Source of Data

- **Processing technology** is based data acquired from the CIRAD laboratory results.
- **Costs of machinery and inputs** are based on manufacturers' interviews.

Inputs:

Fresh biomass: It is harvested by the manufacturer.
Harvesting tasks were given to the manufacturer because he needs to control the harvesting time to process only fresh material.

➢ **Factory: size** and processing were computed for a plant capacity of 17 tons of guayule stem dry biomass per day, during 4 months.

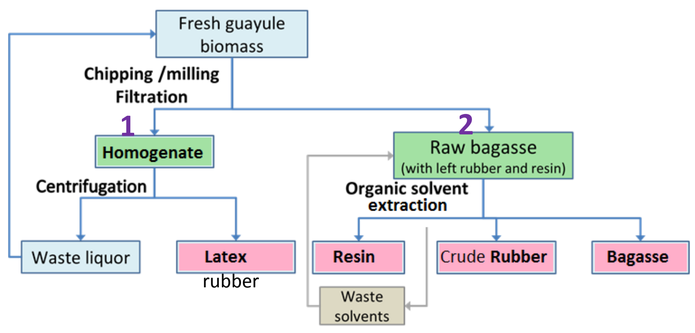
➢ **Costs include:** Buildings,
Fixed costs, Equipment, machinery,
Waste water cleaner,
Variable costs (harvest, transport, …),
Labour, transportation, …

Uncertainty of data:

➢ Data were inspired from laboratory scale information.

Outputs :

1. Latex rubber
2. Crude rubber
3. Resin
4. Bagasse



Results of simulations

Extraction and processing:

Processing:

	Price / ton biomass	
Latex extraction (step 1)	€ 171	€ 550
Solvent extraction (step 2)	€ 79	
Dry biomass purchased (price / ton)	€ 300 (*paid to the farmer*)	

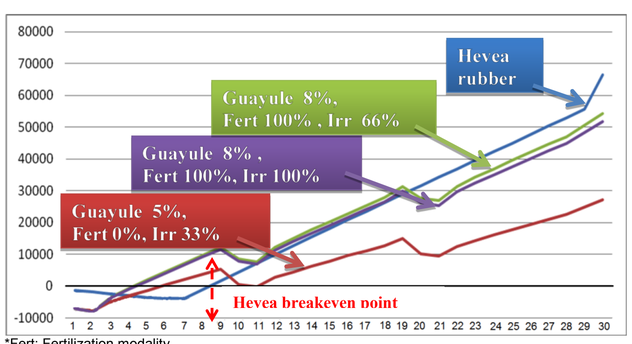
Outputs:

		Price / ton biomass	
Rubber → 9 % of dry biomass			€ 691
25 % as **Latex**	(€ 6.00 / kg)	€ **135**	
65 % as **crude rubber**	(€ 3.60 / kg)	€ **211**	
Resin: → 9 % of dry biomass	(€ 3.0 /kg)	€ 270	
Bagasse: → 75 % of dry biomass	(€ 0.1 /kg)	€ 75	

Benefit for the manufacturer = € 141 / ton biomass

Conclusion

- ✓ Our results show that it is possible to grow guayule in the Mediterranean. The farmer and manufacturer accounts are based on following data:
  - **Planting density**: 50,000 plants /ha
  - **Stem dry biomass yields**: 10 tons /ha /year (average for 10-year culture)
  - Improved **genetic material** and **management** with irrigation and fertilization.
  - **Shrub rubber content**: 8 % of dry rubber (i.e.: 800 kg / ha / year)
- ✓ The above mentioned **production costs** were estimated based on these data and the prices of required inputs.
- ✓ Research should go forward to improve the capacity to extract more rubber and promote the by-products.
- ✓ In order to show the beneficial effect of guayule plant on the environment and development, more efforts should be given to the development of this plant.
- ✓ Based on the current knowledge, guayule cultivation and production is profitable only when both the rubber and resin are marketed; bagasse sale is a bonus.
- ✓ Southern Mediterranean region can be a field to enlarge the development of guayule, which can be a new agricultural sector in the area. For example, in Morocco, more than 50 % of the none-desert land (*Sahara*) are unused semi-arid lands.
- ✓ Compared to Hevea (*tropical rubber tree*), guayule has the advantage of being a faster producing crop giving its cultivation an advantage. However, every 10 years, guayule shrubs have to be uprooted and replanted, giving advantage to the Hevea cultivation over the longer period.



*Fert: Fertilization modality
*Irr: Irrigation modality

Comparison of accumulated balances of *Hevea* and three guayule farming systems
(synthesis of data analyzed with Olympe© software)

References

- ✓ **Technical and economic feasibility of a guayule commodity chain in Mediterranean Europe**. Sfeir N., Chapuset, T., Palu, S., Lançon, F., Amor, A., García García, J., Snoeck, D. (2014) Industrial crops and products 59; p. 55-62.
- ✓ **The challenge of Guayule. An alternative source of naturel rubber a model of bio-refinery**. Palu S., Pioch D., Amor A., Tardan E., Chapuset T., Snoeck D., Bonfils F. (2013) In : International Rubber Research and Development Board Conference. London, UK, June 2013.

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